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ORIGINAL PAPER

Reliance on Social Networks and Health Professionals for Health Information in the U.S. Adult Population

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Abstract
The subpopulation of adults depends on non-online health information sources including their social networks and health professionals, to the exclusion of online sources. In view of the digital divide and health information disparities, the roles of race/ethnicity and digital skills are yet to be explored. A nationally representative sample of 6,830 adults from the Program for the International Assessment of Adult Competencies (PIAAC) was analyzed, using binary logistic regression. Black adults and adults with higher digital skills were less likely to be reliant on non-online health information sources, compared to White adults and those with lower digital skills, respectively. Differences in non-online health information source reliance by race/ethnicity and digital skills might be further nuanced by the relevant demographic and socioeconomic characteristics. Increasing digital skills may expand one's health information sources to include reliable online sources and empower adults to promote their health.

Keywords Health Information-seeking Behavior · Health Information Sources · Digital Skills · Race and Ethnicity

Introduction

Background

Health information-seeking behavior (HISB) refers to an individual's intentional action to find health information [1]. HISB can have advantageous cognitive (e.g., informed decision-making), behavioral (e.g., better communication with health professionals), and affective (e.g., lower health-related anxiety) implications [2]. Adults often use a combination of three health information sources—the internet, social networks, and health professionals [3, 4], because of convenience, anonymity, personalized health information, and access to health experts [5]. The Internet has emerged as the most popular health information source in recent decades [3]. "Internet patients" are well-informed [6] and

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better poised to challenge the longstanding paternalistic physician-patient relationship [7, 8]. Thus, the deliberative model [7]—whereby health professionals support patient autonomy and help determine the quality of health information retrieved from other sources—is encouraged [6].

However, the digital divide [9]—unequal access to and utilization of digital technology by specific individual demographic characteristics (age, gender, race), socioeconomic status (SES), and digital skills—can impact access to online health information [10, 11]. Online health information seekers tend to be younger, female, and White, and have higher education and income levels [10]. Consequently, specific subpopulations (including older persons, racial and ethnic minorities, persons with lower educational and income levels, and those with lower digital skills) are more likely to depend on social networks and/or health professionals as their only health information sources [12], and might be at a disadvantage (e.g., less autonomous health decision-making) compared to their counterparts. Given the nation's public health priorities on health disparities by race and ethnicity, and social determinants of health, such as SES, social environment, and digital/literacy skills [13], further interdisciplinary examination of understudied areas benefits policy discussion in the future.

Unlike demographic characteristics (e.g., age, gender) and SES, empirical evidence regarding race and ethnicity is still scarce in the context of HISB [14]. One of the earlier studies did, however, find a lower likelihood of Internet-based health-seeking behavior among a racial and ethnic minority group [15]. Also, digital skills—one of the most powerful predictors of the digital divide—are unequally distributed by race and ethnicity. In contrast to White adults (57%), Black adults (86%) and Hispanic adults (77%) tend to have lower digital skills [16]. Previous research on race and ethnicity, the digital divide, and online health information seeking utilized regionally and nationally representative data, such as California Health Interview Survey [17] and Health Information National Trends Survey (HINTS) [14]. Yet, these datasets do not provide sophisticated measures of the digital divide in general and digital skills in particular. Therefore, our present study that focuses on the understudied areas of racial and ethnic differences in reliance on non-online health information sources using the large-scale systematic assessment of digital skills is timely and in alignment with the nation's public health priorities [13, 18].

Theoretical/Conceptual Framework

Ronald Andersen's behavioral model [19] was used to guide the design of the present study. Health information sources are categorized within the method dimension of HISB [2]. Thus, the use of health information sources is considered a health behavior, and according to the behavioral model, health behaviors are driven by predisposing, enabling, and need factors [19]. Specifically, a series of predisposing (e.g., race and ethnicity), enabling (e.g., digital skill), and need factors (e.g., poor health) collaboratively determine one's HISB [20]. In this study, we looked exclusively at the method dimension of HISB. Given our working definition of HISB, we excluded several health information sources aligned with passive communication channels such as radio, book, TV, and magazine [21]. Then, we zeroed in on the three main health information sources identified in the literature, namely the internet, social networks (i.e., family, friends, or coworkers), and health professionals [2] (see Fig. 1).

Research Questions

Are race and ethnicity [research question (RQ) 1], and digital skills (RQ2) associated with a reliance on social networks and health professionals as health information sources among adults in the United States?

Hypothesis

Given the demographics of the online [10] and non-online health information seekers [12], and the prevalent digital divide [11], we hypothesized that persons who identify as racial and ethnic minorities, and have lower digital skills are more likely to depend on social networks and health professionals, without using online sources, for health information in the United States.

Methods

Data

This study analyzed the combined data from the 2012/2014/2017 Program for International Assessment of Adult Competencies (PIAAC), U.S. restricted-use file (RUF). PIAAC is a nationally representative large-scale assessment of adult competencies of persons aged 16 years and older. PIAAC assesses information-processing skills including literacy, numeracy, and digital problem-solving skills. PIAAC RUF data license #17080026 was obtained from the U.S. Department of Education, National Center for Education Statistics (NCES), all analyses were complied with the RUF data use guidelines, and this study was approved by the Institutional Review Board of the University of Maryland Baltimore County (Protocol #415). PIAAC provides a unique opportunity to analyze the systematic

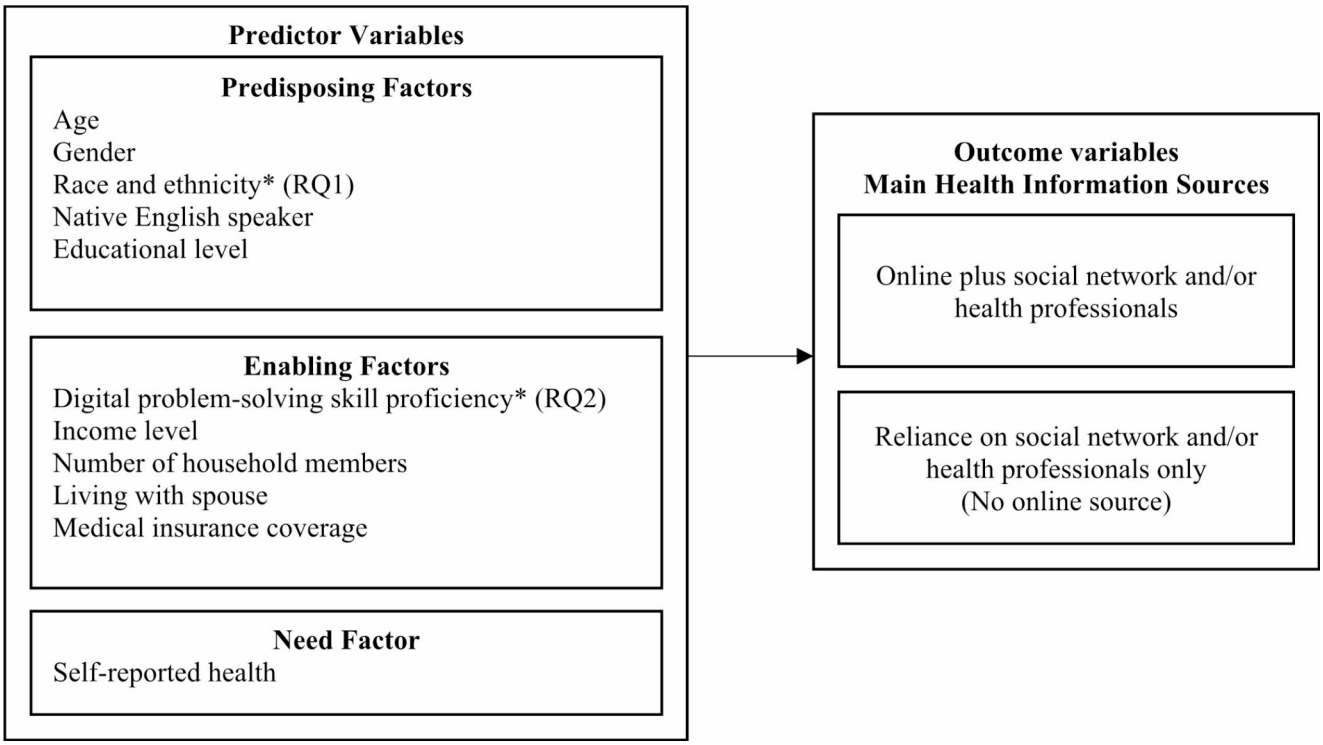

Fig. 1 Conceptual model. Notes: *the main predictor variables. [a] RQ = research question. [b] the outcome variable, main health information sources, focuses on 3 of the 8 health information sources measured in PIAAC

assessment of digital skills (i.e., digital problem-solving skills) at the population level.

This study focused on PIAAC participants aged from 25 to 74 years old (n = 9,800). Due to the digital problem-solving skill assessment-specific screening process (e.g., experience with digital devices), approximately 25% of the respondents (n = 2,460) were not assessed for their digital problem-solving skills. After excluding the respondents with any missing values (n = 510, approximately 7% of the available data), the final analytic sample was 6,830. On a related note, over 90% of the cases with a missing value were from the income measure. The power analysis was conducted using the G*Power application [22]. Given the baseline distribution of the health information source use patterns, the specific Type 1 error rate (alpha < 0.05) and a conventionally accepted statistical power (0.80 and higher), the minimum required sample size for all main predictor variables was between 105 and 359.

Variables

Outcome variables—health information sources

The three health information sources are the internet, social networks (i.e., family members, friends, or coworkers), and health professionals. The four response categories to the question "How much information about health issues do you get from…?" were dichotomized (1 = users [persons who got *a lot* or *some* of their health information from a particular source] and 0 = non-users [persons who got *a little* or *none* of their health information from a particular source]). Then, the participants were classified into online health information seekers, who also utilize social networks and/or health professionals, versus non-online health information seekers, who rely on social networks and/or health professionals only.

Predictor variables [19, 20]

Predisposing factors: Race and ethnicity indicate whether respondents identified as White versus Black, Hispanic, or Other. *Enabling factor*: The digital problem-solving skill proficiency measure is scored from 0 to 500 points based on 10 plausible values (see OECD, 2012 [23] for further information on the digital skill measure in the PIAAC).

Covariates

Predisposing factors: Age is measured in years from 25 to 74. Gender was coded 1 = female and 0 = male. Native English speaker was coded 1 = yes and 0 = no. Educational level was dichotomized into a college degree or higher versus less than a college degree. *Enabling factors*: Income level (0–5) was measured as no income = 0 (derived from the

employment status variable and indicate persons who were not employed) plus a quintile whereby 1 = lowest income and 5 = highest income. The number of household members is top-coded at 6. Living with a spouse was coded as 1 = yes and 0 = no. Medical insurance coverage was coded 1 = insured and 0 = uninsured. *Need factor*: Self-reported health was recorded on a 5-point scale (1–5: poor, fair, good, very good and excellent).

Analytic Approach

The weighted descriptive summary for all variables of interest was estimated by the health information source use patterns. The STATA macro program [24] REPEST [25] was used to incorporate all 10 plausible values of digital problem-solving skill proficiency, the sampling weights (SPFWT0) and 80 replicate weights (SPFWT1-80) into all statistical estimations [26]. To address the research questions, a binary logistic regression was used to model the health information source used as a function of the predictor variables and covariates [27]. A simple (a.k.a., unconditional) logistic regression was used to conduct the bivariate test (i.e., Wald chi-square test). Subsequently, a fully conditional model with all predictors and covariates was constructed for the hypothesis testing. The model predictive accuracy was evaluated based on the area under the receiver operating characteristics curve (ROC ≥ 0.60–0.70, 0.70–0.80, and 0.80–0.90 are considered acceptable, excellent, and outstanding accuracy, respectively) [28, 29]. Also, multicollinearity was assessed using the variation inflation factor (VIF > 4.0 as a sign of multicollinearity) [30]. The statistical significance was evaluated at the alpha level of 0.05.

Results

The weighted descriptive summary is reported in Table 1. About 14% of the adults relied on their social networks and/or health professionals, without using the online health information source. The significance tests showed that adults who rely on their social networks and health professionals tend to be racial and ethnic minority, and have lower digital problem-solving skills, compared to their counterparts. The results from the logistic regression are reported in Table 2. Regarding RQ1, Black adults had 0.55 to 0.81 times the odds of using social networks and health professionals only for their health information, compared to White adults. Thus, Black adults were less likely than Whites to rely on just their social networks and health professionals for health information. However, Hispanic and Other adults were not statistically different from White adults. Regarding RQ2, one point increase in the digital problem-solving skill proficiency score was associated with 0.990 to 0.993 times the odds of using only social networks and health professionals as their health information sources. Considering the VIF is less than or equal to 1.54, the area under the ROC curve equal to 0.69, and sensitivity analyses (e.g., age quadratic term, alternative measures that include using "a little" as the user), the final model was considered acceptable, and findings were considered adequate [28].

Discussion

Although racial and ethnic minorities were expected to be less likely to be online health information seekers [12], our findings indicate otherwise. Additionally, in view of the Andersen's model [19, 20] and existing health disparities by race, racial and ethnic minorities' HISB could be partially driven by heath status (i.e., need factor) [31]. However, considering additional demographic (i.e., age and gender) and socioeconomic (i.e., educational and income levels) factors were found to be statistically significant, more contextual information, such as qualitative data, may be useful to better understand how race and ethnicity and digital skills are relevant to HISB in future research [32]. Thus, although our findings showed that Blacks were less likely to be non-online health information seekers, specific reasons, and roles of health information needs (i.e., health status) are yet to be examined. Future research might consider disentangling the complex relationships with, as well as within group differences by, other relevant predisposing, enabling, and need factors.

As hypothesized, adults with lower digital problem-solving skill proficiency tended to be non-online health information seekers and might be at a disadvantage from not using the three main health information sources [11, 12]. In previous population-level research, digital skills were measured in a simple self-evaluation. PIAAC provided a sophisticated assessment of digital skills in the context of HISB among U.S. adults. The empirical evidence from this study justifies future interventions to improve digital skill proficiency, to address potentially problematic reliance on social networks and health professionals, without online sources, for health information.

This study was not without its limitations. The findings may reflect relatively young adults with basic digital skills due to the age range (25–75 years) and the systematic exclusion criteria (e.g., no prior computer use) in PIAAC. Also, the unavailability of conventional demographic characteristics such as marital status may have resulted in possible omitted variable bias. PIAAC considered not being employed as equal to no income, and this study adopted the

Table 1 Weighted descriptive summary by the health information source use pattern

Variables	All (n = 6,830) [a]	Social networks and/or health professionals only (n = 930) [a]	Internet, plus social networks and/or health professionals (n = 5,900) [a]
	Mean or percentages (standard error)	Mean or percentages (standard error)	Mean or percentages (standard error)
Predisposing factors			
Age (Years)	47.42 (0.10)	53.76 (2.05)*	45.61 (0.14)
Gender (Female)	52.88% (0.35)	48.12% (0.01)*	54.21% (0.58)
(RQ1) Race and ethnicity		*	
White	68.02% (0.62)	64.69% (1.29)	68.99% (0.67)
Black	12.24% (0.19)	13.99% (0.89)	11.73% (0.30)
Hispanic	12.32% (0.40)	15.32% (1.21)	11.44% (0.36)
Others	7.41% (0.51)	6.00% (1.29)	7.84% (0.67)
Native English speakers (Yes)	84.72% (0.60)	83.20% (1.23)	85.13% (0.66)
Educational level (College or higher)	52.37% (0.49)	31.10% (1.24)*	58.56% (0.56)
Enabling factors			
(RQ2) Digital problem-solving skill proficiency [b] (0–500 points)	270.77 (1.00)	250.54 (1.93)*	274.02 (0.99)
Income level (0–5: no income plus quintile)		*	
0	30.55% (0.55)	46.33% (1.51)	25.98% (0.60)
1	9.72% (0.38)	10.59% (0.88)	9.47% (0.39)
2	12.67% (0.36)	13.53% (0.90)	12.41% (0.40)
3	14.81% (0.52)	11.06% (0.83)	15.90% (0.60)
4	15.69% (0.56)	9.77% (0.89)	17.40% (0.65)
5	16.56% (0.52)	8.72% (0.81)	18.83% (0.64)
Number of household members (top-coded at 6)	2.93 (0.02)	2.75 (0.04)	2.98 (0.03)*
Living with spouse (Yes)	66.61% (0.01)	61.71% (1.29)	68.09% (0.78)*
Medical insurance (Insured)	84.91% (0.01)	82.77% (1.16)	85.52% (0.56)*
Need factor			
Self-reported health		*	
Excellent	19.71 (0.60)	11.91% (0.76)	21.97% (0.71)
Very good	32.14% (0.64)	24.73% (1.23)	35.32% (0.70)
Good	29.51% (0.49)	33.44 (1.36)	28.39% (0.53)
Fair	13.61 (0.43)	21.54% (0.90)	11.30% (0.46)
Poor	4.23% (0.27)	8.39% (0.83)	3.02% (0.24)

Notes: *$p < 0.05$ (vs. Internet, plus social networks and/or health professionals)

The sampling and replicate weights were applied

[a] Unweighted sample size rounded to the nearest 10 per the PIAAC restricted-use file data use guideline

[b] 10 plausible values

Data Source: 2012/2014/2017 PIAAC Restricted Use File Data (National Center for Education Statistics, 2017)

same assumption. Additionally, the sequential relationship from Andersen's behavioral model was not explicitly taken into consideration given the objective of the present study.

New Contribution to the Literature

Previous literature examined the demographics of persons who utilize the internet as a health information source [11, 12, 15] and indicated that persons tend to use a combination of main health information sources [12]. Our study extended this line of research by examining who may not be using the full main health information sources, specifically those who solely rely on their social networks and health professionals to the exclusion of the internet. Also, the sophisticated measurement of digital skills in PIAAC has not yet been extensively utilized in the population-level HISB research. The findings on racial and ethnic identities and systematically assessed digital skills added valuable empirical evidence to the literature. Indeed, unlike race and ethnicity, digital skills are malleable and as such, our findings help justify future

Table 2 95% confidence intervals for the estimated odds ratios and standard errors from the binary logistic regression on the reliance on social networks and health professional (versus the online sources plus health professionals and social networks)

Variables	Odds Ratios
	95% Confidence Intervals (Lower limit, Upper limit)
Predisposing factors	
Age (Years)	1.01, 1.02*
Gender (Female vs. Male)	0.63, 0.90*
(RQ1) Race and ethnicity	
White	*Reference*
Black	0.55, 0.81*
Hispanic	0.65, 1.32
Others	0.53, 1.37
Native English speakers (Yes vs. No)	1.09, 2.22*
Educational level (College or higher vs. less than college)	0.65, 0.94*
Enabling factors	
(RQ2) Digital problem-solving skill proficiency (0–500 points)	0.990, 0.993*
Income level (0–5: no income plus quintile)	0.92, 1.02
Number of household members (top-coded at 6)	0.94, 1.10
Living with spouse (Yes vs. No)	0.72, 1.14
Medical insurance (Insured vs. uninsured)	0.93, 1.35
Need factor	
Self-reported health (1–5: Poor – Excellent)	0.85, 0.99*

*$p < 0.05$; The model predicted reliance on health professionals and social networks (versus those who used online sources plus health professionals and social networks) for health information

Notes: The sampling and replicate weights were applied. RQ = research question

[a] Unweighted sample size rounded to the nearest 10 per the PIAAC restricted-use file data use guideline

[b] 10 plausible values

Data Source: 2012/2014/2017 PIAAC Restricted Use File Data (National Center for Education Statistics, 2017)

adult education on digital skills to address health information disparities. In addition, our study lays a foundation for a more complex exploration of emerging health information seeking behaviors through online social networks in addition to conventional social networks such as family and friends [33].

In conclusion, Black adults and adults with higher digital skills are less likely to rely on their social networks and health professionals without online health information, compared to White adults and adults with lower digital skills, respectively. The socioeconomic disparities mirrored in the digital divide seem to create an interconnection among race and ethnicity, digital skills and online health information seeking. Racial and ethnic differences in non-online health information seekers might be better understood at the intersection of additional demographic and socioeconomic factors. Based on our findings, efforts to enhance digital skills could benefit non-online health information seekers and ultimately reduce existing health disparities in the U.S. adult populations.

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